# Radiological Work Planning & Execution

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Each facility is tasked with maintaining personnel radiation exposure as low as reasonably achievable (ALARA). A continued effort is required to meet this goal by developing and implementing improvements to technical work documents (TWDs) and work performance. A review of selected TWDs from most facilities shows there is a need to incorporate more radiological control requirements into the TWD. The Radioactive Work Permit (RWP) provides a mechanism to place some of the requirements but does not provide all the information needed by the worker as he/she is accomplishing the steps of the TWD.

Requiring the engineers, planners and procedure writers to put the radiological control requirements in the work steps would be very easy if all personnel had a strong background in radiological work planning and radiological controls. Unfortunately, many of these personnel do not have the background necessary to include these requirements without assistance by the Radiological Control organization at each facility. In addition, there seems to be confusion as to what should be and what should not be included in the TWD.

**REQUIREMENTS**

This is not an inclusive list of requirements as related to radiological controls for TWD. These are the primary ones relating to the provisions dictating those controls be placed into the TWDs.

> **DEPARTMENT OF ENERGY PART 835--OCCUPATIONAL RADIATION PROTECTION**-- Subpart E--Monitoring of Individuals and Areas Sec. 835.**401**
> General requirements.

(a) Monitoring of individuals and areas shall be performed to:

(1) Demonstrate compliance with the regulations in this part;
(2) Document radiological conditions;
(3) Detect changes in radiological conditions;
(4) Detect the gradual buildup of radioactive material;
(5) Verify the effectiveness of engineering and process controls in containing radioactive material and reducing radiation exposure; and (
6) Identify and control potential sources of individual exposure to radiation and/or radioactive material.

**HSRCM-1, ART 551 Radiological Monitoring and Surveys (Implements 835 through RPP)**

**551 Requirements**

1. Radiological monitoring of radiation exposure levels, contamination and airborne radioactivity shall be conducted to characterize workplace conditions, to verify the effectiveness of physical design features and engineering and administrative controls, and to identify areas requiring postings.

2. Monitoring shall be performed only by trained and qualified personnel using instruments that are properly calibrated and routinely tested for operability.
3. Surveys for radiation, contamination and airborne radioactive materials shall be performed as specified in Technical Work Documents and Radiological Work Permits.
4. The Radiological Control Organization shall perform and document a review of the adequacy of sampling and monitoring systems as part of any facility or operational changes affecting radiological control. In the absence of such changes, a review should be conducted annually.
5. Instruments used to perform radiation surveys shall be readily available and response-checked daily or prior to operation. When response checks are not within ±20 percent of the expected value, the instrument should be taken out of service. When response checks are not feasible, such as with instruments used to measure neutrons or tritium, compensatory actions should be established to ensure proper instrument performance.
6. Assessment of radiological conditions should include a sufficient number of survey points to characterize the radiation present and to verify boundaries.
7. Surveys should be performed before, during and at the completion of work that has the potential for causing changes in levels of radiation and radioactivity.
8. Survey frequencies should be established based on potential radiological conditions, probability of change in conditions and area occupancy factors.
9. Monitoring results should be reviewed by the cognizant radiological supervisor. The review should ensure that all required surveys have been performed and that the documentation is accurate and complete.
10. Results of current surveys or survey maps should be conspicuously posted to inform personnel of the radiological conditions.
11. Monitoring results should be made available to line management and used in support of pre- and post-job evaluations, ALARA preplanning, contamination control and management of radiological control operations.
12. Monitoring data in each building or area should be compiled and reviewed at least quarterly. Changes or trends should be noted and corrective actions assigned.

**HSRCM-1, Article 315, Technical Work Documents:**

13. "Technical work documents, such as procedures, work packages, or job or research plans, should be used to control hands-on work with radioactive materials. Technical work documents are not required for incidental or routine work activities that involve a low potential of worker exposure or workplace contamination, such as the collection of trash or used protective clothing.
14. Technical work documents used to control radiological work activities should be reviewed and approved by the Radiological Control Organization.
15. Radiological Control Hold Points should be incorporated into technical work documents for steps that require action by the Radiological Control Organization to prevent radiation exposures in excess of Administrative Control Levels, high airborne radioactivity concentrations, or the release of radioactivity to the environment."

These requirements are centered on ensuring all safety instructions are placed in the documents used to perform work. Many times we are lured into a false sense of security by relying on the "Skill of the Craft" to ensure items are performed as required. We assume that because a worker is "qualified or certified" that they will do everything absolutely correct. Even the best worker in a particular field will make mistakes. Many other factors are at work during a job evolution that can affect performance. The quality of pre-planning, pre-job briefs, scheduling, priorities, multitude of requirements, and even the effect of non-work related events can lead to a mistake in the field. It only makes sense to place those items that you need to ensure proper completion of, are in the TWD to guide the worker and minimize potential problems.

**Technical Work Documents**

A technical work document is a generic term used to describe approved documents that are used to direct work, such as work packages, technical procedures, research plans, test plans, etc. Even engineering documents such as drawings and engineering changes can be considered TWD due to that many contain not just what is to be changed or installed, but can say how it is to be installed.

A TWD needs to contain instructions for all associated personnel to safely perform the work. The use of multiple documents to perform work is discouraged because it is an error prone way to performing work. Jumping between documents can lead to confusion and result in missing a step. A good example of this is using your RWP to contain all the controls and the TWD the work steps. In order to be successful at this, you have to know the RWP word for word and constantly be cross-referencing between the TWD and RWP to identify which control to use or apply.

In a teaming approach to performing work, it is very important for all the team members to understand what each of the others job steps are. If you rely on "skill of craft" completely for implementing your controls instead of written steps, it is very easy for that operator or maintenance craft to forget or not realize that a radiological control action or verification was needed to be performed at a certain point of the work. If it is in the instructions, you are less apt to miss the action or verification.

**Guidelines for Incorporating Radiological Controls in Technical Work Documents**

Radiological Controls that are incorporated into technical work documents (TWDs) fall into two general categories: (1) instructions that define how the work is engineered and (2) instructions that specify key actions to be performed during the work. Instructions in the second category are included to coordinate actions among radiological control and operations/maintenance personnel.

While the TWD specifies some of the radiological controls for the work, it is neither necessary nor desirable that all radiological controls be specified by the TWD. Such a practice would: (1) increase the complexity of the TWD preparation and execution, and (2) unnecessarily delay work in progress to process changes to the TWD when radiological conditions require minor changes to the radiological work practices during the course of the work.

Additionally, such detailed radiological controls are not necessary, because workers are trained/qualified in their "skill-of-the-craft", supervised and HPTs provide radiological control oversight of radiological work.

Examples of radiological controls that should not be specified in TWDs include the following:

a. Routine radiological surveys, such as general work area status surveys, release of materials and equipment, personnel surveys, etc.

b. Routine work practices, changing gloves, bagging materials, etc.

For most radioactive work, the individual who prepares the TWD should independently incorporate appropriate radiological controls into the procedure. When work is of a unique or highly complex nature and is expected to exceed the trigger levels for a formal ALARA or radiological review, the individual who is preparing the TWD should consult with the facility radiological control organization. This individual will need assistance in determining the radiological control requirements and accomplishing a formal pre-job ALARA review. This is best accomplished early in the planning process to avoid delays later and ensure the radiological considerations are factored into how the work is engineered and executed.

**Radiological Control Instructions that Specify How the Work is Engineered (Engineered Controls):**

The TWD should provide the basic instructions but need not reiterate detailed instructions or work practices that are adequately covered by other documents and taught in facility training programs. However, enough detail is required to allow for the reviewer and performer to be sure how and what work is planned to be done. Examples showing the types of work steps that should include radiological controls are:

(1) **The type of metal removal tool (i.e., grinder, cutting machine, file, etc.) to be use for the work.**

If the use of different tools is optional, the TWD should specify the preferred technique and the radiological controls required for use of each type of tool.

(2) **Use of a radiologically controlled ventilation system or HEPA filtered vacuum cleaner.**

The work package should include a sketch of the ventilation system and show the flow paths of how air will enter the containment, if installed, and be exhausted. As a prerequisite, the TWD should require an aerosol test by vent/balance personnel and other tests as appropriate, i.e., smoke testing to ensure flow paths are proper or flow rate determinations.

The TWD should include special instructions related to the ventilation system. For example: the TWD might specify the location of the ventilation suction hose just prior to performing work steps that may produce airborne contamination, i.e., grinding, machining, buffing, etc.

(3) **Use of radiological tents, glove bags or catch basins.**

At Hanford, containments are fabricated by the PFP Plastic Shop or procured through private vendors. Some frequently used containments have been placed in spare parts for purchase by all facilities. These containments are installed, certified and removed per HNF-EP-0749, Radiological Containment Guide. The TWD should require the containment or glove bag be certified by Radiological Controls personnel prior to use and at least daily while work is in progress. The step to initially certify the containment should include a Radiological Hold Point.

Special instructions needed to design unique containments should be included in the work package and referenced in the TWD as required. If a radiologically controlled ventilation system is installed, refer to paragraph (2) above.

If the job involves work with fissionable materials, the make-up air is required to enter the containment through HEPA filters or back-flow preventers. Contact the Criticality Safety Representative to approve the design of the system.

If the system is to be used during hot work, a spark arrestor should be specified to prevent a fire in the filter.

Significant changes in the way a containment is used during the steps of a job may require a step in the TWD to ensure it is properly posted and controlled. For example: if the containment is required to be posted as an "Airborne Radioactivity Area" to accomplish grinding, the TWD should include a step to ensure the posting is changed so workers realize that a major change in PPE is required.

(4) **Methods to minimize generation of mixed waste when hazardous materials must be used in areas where they will become radioactively contaminated.**

These instructions should include using minimum quantities, substituting non-hazardous materials and taking measures to prevent them from becoming contaminated, i.e., wrap the container in plastic. Consideration should be given to including instructions to ensure the mixed waste is segregated from other radioactive waste generated during work.

(5) **Maximum quantity of radioactive liquid to be expected during work evolutions.**

Ensure the method used to contain residual liquids or collect larger quantities is covered by the TWD and approved by Criticality Safety, if required. If the work is inside a containment and a drain is required to be installed, ensure the TWD requires the containment to be leak tested as part of the installation process and the drain and associated collection facility are installed properly. Consider adding instructions to minimize the quantities of radioactive liquid waste created, if appropriate.

(6) **Performance of decontamination or other actions to remove or "fix" contamination.**

For example: (1) decontaminate the work area prior to the start of work and periodically during the job; (2) the work area could be painted with strippable latex decon paint or a fixant so there is less removable contamination; (3) "spritz" the work area with water or lay damp rags in the work area to cover the contamination. These actions reduce the risk of spreading contamination and may allow a reduction in PPE by radiological control personnel.

(7) **Installation or removal of temporary shielding if not part of another work package.**

Consider having temporary shielding installed in the work area and travel paths to the work area. Obtain a recent copy of the work area radiological survey and discuss with the Health Physics Analyst, Senior HPT or Manager. Administrative procedure, RP-14-006, Temporary shielding control, addresses this activity.

(8) **Installation of temporary personnel barriers around localized high radiation areas to prevent workers from getting near high radiation areas.**

Also consider flushing "hot spots" to remove the radioactive source.

(9) **Installation of protective covers that are installed prior to the start of work to prevent damage to other components which could result in additional work in the radiation area.**

(10) **Establishing, disestablishing or modifying high or very high radiation or contamination areas.**

(11) **Special packaging requirements for movement of radioactive tools, material or equipment if different than normal packaging techniques.**

(12) **Special handling or transfer requirements for disposal of radioactive material or liquid if different than normal handling or transfer techniques.**

(13) **Use of other types of specialized "engineered controls" such as robotics, cameras, communication systems, special tooling, etc.**

**Radiological Control Instructions that Specify In-Process or Situational Actions to be Performed by Workers or HPTs (Administrative Controls):**

The following radiological control instructions should be incorporated in TWDs, as applicable, to coordinate specific actions between operations, maintenance and radiological control personnel. Put simply, you need to place the appropriate controls at points where you have the potential for a change in radiological conditions during the work. This includes before, during, and after the work evolution.

(1) **Contamination Control:**

(a) Specify when a containment tent, glove bag, catch basin, etc, should be installed, certified and removed.

(b) Specify contamination surveys whenever conducting operations that have been known to result in or that are expected to result in the spread of radioactive contamination. Examples of such operations include: (1) breaching a radioactive system, (2) removing components or equipment that expose previously inaccessible contaminated surfaces, (3) evolutions that release radioactive or potentially radioactive liquid in the work area, (4) evolutions such as grinding, filing, or machining that have a potential of generating loose surface contamination, (5) prior to removing or opening a glove bag, and (6) changing the posting of a catch-basin contamination area. Note: These examples are not intended to be an all-inclusive list.

(c) Specify fixed radioactive contamination surveys prior to working on surfaces such as the following, if these surfaces were previously exposed or were suspected of being exposed to radioactive liquids or radioactive contamination: (1) painted surfaces, (2) concrete, (3) asphalt, (4) soil, and (5) surfaces with residue to be removed. Note: These examples are not intended to be an all-inclusive list.

2. **Exposure Control:**

(a) Specify radiation surveys whenever operations are performed that might change radiation levels. Examples of these operations include: (1) installing, removing, or reinstalling temporary shielding, (2) draining, lowering, filling, or increasing the liquid level in tanks containing radioactive liquids or are used for shielding for highly radioactive sources, (3) draining, lowering, filling, or increasing water level inside a radioactive piping system or component, (4) removing highly radioactive components or equipment, and (5) flushing radioactive systems. Note: These examples are not intended to be an all-inclusive list.

(b) Specify the need for radiation surveys when the contact radiation levels on material or equipment removed during work is expected to be high, i.e., >100 mrem/hr.

(c) Specify radiation surveys on HEPA filtered vacuum cleaners or ventilation systems that are used near highly contaminated surfaces or radioactive liquid collection systems that are likely to have an increase in radiation levels during use.

3. **Airborne Radioactivity Control:**

Specify airborne radioactive contamination surveys during radioactive work that has been known to cause or is expected to cause airborne radioactivity. Examples of such work include the following: (1) initial breaching of a radioactive system if the work is performed in a catch-basin or area that is controlled as a Contamination Area, (2) root pass welding of consumable insert butt welds on radioactive systems, (3) opening and initial entries of confined spaces, tanks or areas that contain radioactive systems, (4) handling radioactive material in a Contamination Area if surface contamination levels are high, and (5) machining or grinding contaminated surfaces outside containments in areas controlled as Contamination Areas. In addition, the new revision to 10CFR835 requires that air sampling be performed under some specific conditions, such as when a respirator is worn. Note: These examples are not intended to be an all-inclusive list.

4. **Other Radiological Control Instructions:**

(a) Fabrication, installation and/or removal instructions for catch basins, glove bags and containment tents. These instructions should include special techniques or requirements related to the installation and testing of portable HEPA filtered ventilation systems and temporary radioactive liquid collection facilities.

(b) Special radiation/contamination surveys on grid maps showing the location of survey points if the TWD requires a special survey be recorded for record purposes.

**Radiological Hold and Inspection Steps in TWDs:**

Radiological hold points are special work steps that are specially identified and have specific completion requirements. The Hold Point designator is normally placed at those steps where omission or incorrect accomplishment of the step could cause a significant radiological problem.

Radiological Hold Points should be incorporated into technical work documents for steps that require action by the Radiological Control Organization to prevent radiation exposures in excess of Administrative Control Levels, high airborne radioactivity concentrations, or the release of radioactivity to the environment. {HSRCM-1, Article 315}

These steps, which require an inspection by radiological control personnel, are required to be signed off before work can proceed. Hold Points may also be included to ensure surveys or other actions required by HPTs are performed at critical points. A signature block may be used for other applications, such as to verify survey completion, containment installation, survey adequacy or that some other radiological requirement has been met or designated steps taken.

If the work step(s) may potentially result in these requirements being met or exceeded, an evaluation of the need for a radiological control hold point (HP) is an appropriate identification of a radiological hazard and corresponding control.

The presence or potential presence of radiological hazards applicable to implementation of radiological hold point requirements should be identified in the job hazards identification and control process.

Radiological Control personnel shall either specify or concur with the presence or absence of radiological control hold points in technical work documents. Final determination of the need for radiological control hold points in technical work documents normally occurs after the hazards and controls are identified, as part of the job-planning phase.

Normally, it is anticipated that low radiological risk jobs or activities will not have the potential to qualify for specification of radiological control hold points.

**Format of Instructions in TWD**

General procedure writing techniques dictate some methods to be used when writing technical work documents. These are designed to minimize personnel error in the performance. This is not meant as an all-inclusive list.

1. Each step should only include one action per step.

2. Notes and caution statements need to be placed immediately preceding the step they are referring to. In addition, do not break notes, cautions, and step onto different pages. Keep together.

3. Steps need to answer several questions:

   - Who
   - What
   - When
   - Where
   - Parameters

   Who is performing the step makes it clear the person to take the action. What to be performed makes clear the intended action, i.e. - What kind of survey. When makes clear at what point in the work you expect an action. Where makes clear the intended point of action. And parameters make sure the person know what the limits or parameters that are to be met.

4. Statements need to be as concise as possible without leaving out any necessary information. It has been shown that if you give them too much to read, they will miss something.

**Reviewing a TWD for Inclusion of Radiological Controls**

Whether you are reviewing a procedure, plan, work package or anything else, you must use a systematic approach to review. Very large or complex work evolutions may require several interations and variations of these general rules to ensure adequate controls are placed into document.

**Planning/Reviewing Personnel Needs:**

1. You must completely understand the work to be performed. This may require walkdowns, interviews, document reviews, etc. Until you understand what they want to do, you cannot begin to use your experience to help them incorporate dose reduction techniques or even place even the most basic radiological controls into the work. Must have and use history files of similar work.

2. You must have a basic understanding of electrical, mechanical, and fluid principles in order to gain an understanding of the work. If you don't understand the basics of these types of principles, you cannot effectively identify potential problem areas that will need attention.

3. You must know your plant and systems, both physically and radiologically. Without this basic knowledge, your planning efforts will be in vain.

4. You must know your planning and procedure preparation processes. This includes any environmental permits you may be obligated to.

5. You must know the abilities and skills of the workers performing the job. You have to know radiological skills training they have received and how effective it is being used in the field.

6. You must be knowledgeable of all available radiation, contamination, and airborne control techniques and methods. If you don't have tools to use to mitigate potential problems, you cannot begin ensure proper controls are implemented.

**Basic Process:**

1. The work steps must contain enough detail to ensure you have an adequate understanding of the work as well as ensuring that the work is performed as planned. Too much flexibility can be a two-edged sword. It may seem to allow for changes as we proceed but it can easily over complicate the work if you try to put in controls for any way they may do something. Set a method and write it that way. In the same way, too much detail can complicate the work also and lead to problems. Only experience and trial can help you to balance this.

2. Make sure the work steps flow correctly. It is typical to see steps out of order so that they do not make any sense. Get assistance from the writer or expert on the system so you can ensure you know what they want to do.

3. Look for those steps where you have the potential for a change in radiological conditions, release to the environment, etc. Assist the writer in incorporating reduction techniques to reduce the risk during the work.

4. Determine criteria you want met at these points. Contamination levels, radiation levels, etc.

5. Develop action statements as discussed above for these criteria.

6. Ensure inserted correctly into document. Do not sign or approve until correctly updated.

**Environmental Permitting**

Many activities will invoke some kind of environmental permitting requirements. Many of these will involve radiological controls. As the radiological control expert, it will fall to you to ensure the correct implementation of these controls to meet the permit. This necessitates that you are familiar with the active environmental permits. The environmental group merely ensures the requirements are being met, but it is usually left to us to implement in the field.

**Radiological Work Permits**

The RWP is an administrative mechanism used to establish radiological controls for intended work activities. The RWP informs workers of area radiological conditions, generic controls and entry requirements, and provides a mechanism to relate worker exposure to specific work activities.

**Key Points:**

The RWP is not a replacement for an operating or work procedure or controls in those procedures except as allowed by the requirements. Although it may be the easiest for everyone, it strikes fundamentally at the core integrated planning and team planning. If we all plan and write in our own little world, whether radiological, planning, safety, etc, we lose our ability to use everyone's experience and knowledge together. If the planner writes the work steps, you write the RWP, safety writes the safety plan, etc, you end up with several different documents to control the work and chances of success are slim. Keep the RWP as what it is, a permit to perform work.

A RWP should have your minimum requirements and the most basic of instructions. An approved RWP will be used when performing any work involving radioactive material, or when accessing radiological areas, except for short term emergency response activities, which will be controlled by emergency response procedures.

Typically, facilities will have "skill of craft" type work evolutions which do not require formal work instructions. In this case your RWP would be your only controlling document. It is of utmost importance that you only allow work to be done this way that has little or no risk for changing conditions. A good rule of thumb is that if you need a job-specific RWP instead of a general to do the work, it has a risk of changing radiological conditions and should be controlled properly with instructions in a TWD.

Avoid concentrating a wide variation of work on a single RWP. This reduces your ability to separate dose for the tasks, makes the RWP very complex and usually error prone to follow. Use a general RWP for those low or no risk activities that generally do not require any special controls. Use your job-specific RWPs for those other things. Yes, you will have more RWPs to keep track of and control and revise and such, but you will avoid many problems associated with work execution errors.

**Preparers Skills and Knowledge:**

RWP Preparers should have the experience and academic training or background sufficient to understand the radiological significance, consequences, and the potential radiological safety concerns inherent in work activities described in the work packages. Those items mentioned above for a work reviewer are applicable to RWP Preparers also.

## Radiological Risk Assessment

Radiological risk assessment must be a fundamental part of your planning process. Without a risk assessment element, you will spend your valuable time over planning or under planning work. This will result in not only wasting your time, but ineffective controls in the TWD or over controlling work making it cumbersome and error prone. With a proper risk assessment, you can decide quantitatively what requires the most attention. Experience, history and training are fundamental in performing a good risk assessment. This element is a fundamental part of Enhanced Radiological Work Planning.

**Radiological Screening**

1. Radiological screening identifies the initial radiological risk level of the work (high, medium, or low; see example risk levels below). If the work is identified as having high or medium radiological risk, RadCon must participate in the conceptualization and walk down phases of the work planning. If the work is identified as having low radiological risk, RadCon planning can be informal and performed in conjunction with the issuance of an RWP. Pre-job or current surveys are a must for beginning this activity.

   A high-risk level would require at least a formal ALARA review and Higher Level Review. A Medium risk level would require at least a formal ALARA review.

   The radiological screener must have these questions in mind when initially assigning radiological risk.

   - Is the proposed work an infrequent or first time activity as per Article 313 of HSRCM-1? If you research this criteria of the HSRCM-1, you will find that this is directed at those facilities that operate a routine, recurring process operations. In other words, those who do the same thing over and over and that is all they do. This is a criteria for those in this category to trigger them to do a little extra review and planning when they stop to do something different than they are used too. When you operate these types of processes, you lose your edge when it comes to shifting gears to new things or things you do not do with any frequency.

   - Will any radioactive systems be breached?

   - What is the radiological history of the system?

   - What is the radiological history of similar work and are there any lessons learned?

   - How much radioactive waste will be generated and what will be its physical form? Will any mixed waste be generated?

   - What are the initial radiological conditions and what conditions will be created by the work?
     - Airborne Radioactivity?
     - Beta and gamma dose rates (whole body and extremity)?
     - Surface contamination (alpha, beta-gamma) and form of contamination?

   - Will the work involve cutting, drilling, grinding or welding on potentially contaminated surfaces?

   - Are there any surfaces that will be disturbed that have painted contamination?

- Based on radiological data collected or assumed, will any ALARA Trigger levels be reached?

- What engineered controls can be used to mitigate the radiation/contamination levels and minimize the waste created?

The information gathered by these questions would be used to assess the job risk and determine Radiological Work Permit requirements that will affect job planning. Use your experience with the same or similar work, job history files, sample results, survey results, etc. in performing this assessment. You may not know some of the answers and may need to track down the information from other professionals. You may need to use your experience in the end to make a decision. Don't be afraid of making a decision!

Probably the hardest to organize is the dose criteria. This requires a person-hour estimate from the performing craft as well as current dose rate data. Person-hour estimates are probably the most error prone part of the equation. In addition, how do you look at these activities? Is it something that you will be doing once or repeatedly over several years? If it is a one-time evolution, it is simple. If it will be a recurring operation, you must decide what time period to evaluate against. Do you look at one evolution, two, ten or one year, two years or ten years? Referring to the criteria below, a job that takes 10 person-mrem per job and done 12 times a year would give you 5000 person-mrem in 41 years. So is it a high-risk job? Probably not! You must decide on a reasonable factor to use in determining this. Probably the most reasonable is a one year time frame. Usually your dose goals and performance indicators are aligned against this periodicity and would give you a better benchmark for evaluating. As far as how often you will be doing the evolution, you need to know the reliability of components if a corrective maintenance item or the required frequency if a preventative maintenance or operational item. Your maintenance and engineering staffs are the resource to use for this determination.

**Example Risk Criteria:**

**High Risk**

1. *Collective Whole Body Dose*

   Estimated collective whole body dose for the task greater than 5000 person-mrem.

2. *Whole Body Dose Rate*

   Whole body dose rates greater than 5 rem/h in the work area.

3. *Airborne Radioactivity Concentration*

   Potential airborne radioactivity concentrations greater than 10 DAC.

4. *Contamination Levels*

General work area (large area) removable contaminations greater than 1,000,000 dpm/100cm (beta-gamma) or greater than 20,000 dpm/100cm (alpha).

5. *Environmental Release of Radioactivity*

A realistic chance of exceeding the unusual occurrence levels as defined by DOE-M-232.1.

6. *Complex or Unusual Task*

A complex or unusual task that, in the judgement of the planning team or screener, has high enough inherent risk to warrant the attention of the ALARA committee.

7. *High Risk of Degenerating During Implementation*

A moderate or low risk task with a realistic potential to degenerate into a high risk undertaking during implementation

8. *High Inherent Risk*

Any task that the planning team or Radiological Control thinks has high enough inherent risk to be reviewed by the ALARA committee.

**Medium Risk**

1. *Individual or Collective Whole Body Dose*

Estimated individual or collective whole body dose for the task within the range of >1000 - 5000 person-mrem.

2. *Whole Body Dose Rate*

Whole body dose rates within the range of >1 - ≤ 5 rem/h in the work area.

3. *Airborne Radioactivity Concentration*

Predicted airborne radioactivity concentrations within the range >1 - ≤ 10 DAC.

4. *Contamination Levels*

General work area (large area) removable contaminations within the range of >100,000 - ≤ 1,000,000 dpm/100cm (beta-gamma) or within the range >2,000 - ≤ 20,000 dpm/100cm (alpha).

5. *Environmental Release of Radioactivity*

   Any task with a realistic chance of exceeding the off-normal levels as described in DOE-M-232.1.

6. *Poor Characterization or History*

   Any task for which the radiological conditions have not been characterized or for which an adequate history does not exist.

7. *Low Risk Task Benefiting from Review*
   Any task ordinarily classified as a low risk task, that Health Physics and/or ALARA staff thinks should be reviewed by a Planning team.

**Low Risk**

1. *Any work in a radiological area not meeting any of the high or moderate risk trigger levels.*

2. *Task Not Benefiting from Review*

   Task that would otherwise be categorized as moderate risk, but which the Radiological Control and ALARA staffs agree would not benefit from the ALARA process designed for moderate or high-risk tasks.

**Summary**

To summarize, you need several key elements in your program in order to successfully integrate radiological controls into technical work documents to protect the workers and the environment and to execute the work with minimal problems.

- You must understand the requirements and principles for placing controls in TWDs.
- You must understand what a TWD is.
- You must have a process for planning, review and control incorporation. Must be integral to the overall planning process.
- You must have experienced, knowledgeable, trained, capable, and motivated personnel performing these radiological reviews.
- You must have the tools available, both engineered and administrative, to allow the radiological planner the flexibility to tailor the controls to the work.
- You must use the team planning approach for greatest chance of success.
- Instructions need to be clear and concise.
- You have to know something about everyone else's job and expertise and not be afraid to tap others as a resource.
- You need to know your facility, processes, and people.
- You must be a resource not a hindrance.